

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
29 April 2004 (29.04.2004)

PCT

(10) International Publication Number
WO 2004/036067 A2

- (51) International Patent Classification⁷: F16C
- (21) International Application Number:
PCT/GB2003/004470
- (22) International Filing Date: 14 October 2003 (14.10.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
0223707.1 14 October 2002 (14.10.2002) GB
- (71) Applicant and
(72) Inventor: PIKE, Anthony, Bruce [GB/GB]; 10 Auckland
Close, Upper Norwood, London SE19 2DN (GB).
- (74) Agents: BAIN SMITH, Timothy et al.; Raworth Moss
& Cook, Raworth House, 36 Sydenham Road, Croydon,
Surrey CR0 2EF (GB).

- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BEST AVAILABLE COPY

(54) Title: LINEAR BEARING

(57) Abstract: A bearing (1) having a frame (2), the frame at least partly surrounding two matrices (12, 16), each of a plurality of spheres (10) which are mounted for rotation so that the spheres in each matrix when the matrix is flat lie in a substantially single plane, the plane of one matrix being parallel to that of the other; the spheres of one matrix are so located that they mostly lie against the spheres on the other matrices so that rotation of the spheres of one matrix results in counter-rotation of spheres of the other matrix; the bearing formed in such a way enables the bearing to be pushed or pulled under an object such as a patient lying on the ground with little or no movement transmitted to the object/patient as the bearing moves between the object and an underlying surface. The bearing can also be used for massaging a patient who is unable to move his or her body or for bearings with civil engineering applications.

WO 2004/036067 A2

LINEAR BEARING

The present invention relates to linear bearings.

5 Linear bearings are used for a number of purposes, for instance ball conveyors as shown in GB Patent No 543,524 (Curran) and GB Patent No 1,263,456 (NRDC). The principle of ball conveyors has been used for moving loads such as boxes or workpieces and also for patients in a hospital.

10 The present invention is also designed in different forms to cope with the problem of moving objects of the same width as above including heavy structures like bridge components as well as for handling patients.

15 Rescue stretchers are either rigid or flexible and are normally placed to one side of a patient who is then lifted or rolled (termed "logrolled") on to the stretcher. Both methods of placing the patient on the stretcher are
20 dangerous since spinal injuries can be aggravated by the action of lifting or rolling. In order to prevent further injury where spinal injury has already occurred, it is clearly necessary if possible to move the patient onto a stretcher without disturbing the patient, particularly
25 moving the patient's head relative to the rest of the patient's body.

A linear bearing according to the present invention comprises a frame at least partly surrounding two matrices
30 each of a plurality of spheres, each matrix when flat having its spheres mounted for rotation in substantially a single plane, the plane of one matrix being parallel to that of the other matrix, the spheres of one matrix located so as to lie at least mostly against the spheres of the other matrix so
35 that rotation of spheres of one matrix results in counter rotation of spheres of the other matrix.

The juxtaposition of the spheres enables the bearing to be pushed or pulled under a patient lying on the ground after an accident with the lower surface of the lower matrix spheres acting on the ground and the upper surface of the upper matrix spheres acting on the patient. Rotation of the lower spheres in one direction causes the upper spheres to rotate in the opposite direction. The result is that little or no movement is transmitted to the patient as the bearing moves under the patient.

In an alternative use for the bearing, it can be slid under a patient on a bed and the patient lifted to change a sheet.

Also the bearing can be slid under a patient subject to bed sores and moved to and fro to massage the patient. This is particularly advantageous where the patient is unable to move his or her body.

The matrices should be arranged to hold the spheres of each matrix separate from each other but sufficiently close that the spheres of the lower matrix support the spheres of the upper matrix. The spheres are preferably arranged to be held in each matrix by means of a sheet of material having holes of a diameter smaller than that of the spheres so that each hole locates each sphere in the correct geometrical position in the matrix. Preferably the perimeter of the pair of matrices is defined by a frame to which the material holding the spheres may be fixed. The frame may have loops or toggles so that the bearing can be grasped or hooked onto for manoeuvring.

In one embodiment the bearing of the invention has means for attachment to an inflatable secondary bearing. The secondary bearing may have detachable poles to enable it to be carried as a stretcher.

In a further embodiment the bearing of the invention may itself have suitable means to enable it to be carried as a

stretcher, straps being provided to hold the patient on the bearing.

Because the present invention provides an excellent solution to the reduction of frictional forces between two bodies which are required to be or inevitably will move relative to each other, the invention may be applied to both rectilinear and curvilinear including sphericolinear situations where the bodies which require to move relative to each other can be enabled to move either two or three dimensionally relative to each other. Take, for example, in tidal waters, where a ship is moored alongside a jetty, a gangway is provided to access the ship from the jetty. In such a case, the ship moves relatively to the jetty up and down and to an extent along the jetty and slightly towards or away from the jetty. In such a case, it is conventional to secure the gangway to the ship in such a way that the inboard end can move in a vertical plane and slightly pivot in the horizontal plane whilst the outboard or jetty end can move both in a vertical plane and move in the horizontal plane. Such movement which is allowed for is however subject to restraint by inboard tackles and needs to be watched by gangway staff. A similar problem arises when accessing pontoons.

In another example, offshore oil production platforms are connected to accommodation platforms by bridges. In some conditions, there is relative movement between platforms at least at the height where the bridges are required. It is therefore important to allow for such relative movement. Otherwise the bridge will not stand the relative forces involved.

In a further example, large structures such as bridges need to be able to move slightly and within limits relative to the bridge supports. In some cases, this is normally enabled by providing elastomeric bearings. However, these

do not always last long and although individually relatively cheap are very expensive to replace.

A still further example for use of the invention is where there is thermal expansion between large structures which if not allowed for would cause unacceptable stress between the structures such that one or both structures could eventually fail.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a part of a bearing according to one embodiment of the present invention;

Figure 2 is a vertical cross section of the bearing of Figure 1 taken at A-A;

Figure 3 is a plan view of part of the bearing of Figure 1;

Figure 4 is a perspective view of the bearing of Figure 1 attached to an inflatable stretcher;

Figure 5 is a plan view of a second embodiment where spheres are threaded into an upper and lower matrix;

Figure 6 is a plan view of the second embodiment showing the spheres woven in the matrices;

Figure 7 is a cross section of a bearing in the form of a platform taken on Y-Y of Figure 8, according to the invention;

Figure 8 is a plan view of the further embodiment of Figure 7;

Figure 9 is an exploded perspective view of the platform of Figure 8;

Figure 10 is a diagrammatic view of another embodiment of the invention showing a spherically linear bearing and a rectilinear bearing;

Figure 11 is a diagrammatic side view of a resilient linear bearing according to an alternative embodiment of the invention; and

Figure 12 is a diagrammatic view of a rotatable or rectilinear movable bearing according to a still further embodiment of the invention.

15

The bearing in the form of a mat of Figure 1 is formed with a frame 2 made of a flexible plastics material having a chamfered edge 4 and supporting an upper perforated sheet 6 and a lower perforated sheet 8. The upper perforated sheet locates a plurality of spheres 10 and together they form a first matrix 12. The lower perforated sheet 8 locates rows of spheres 14 which form a second matrix 16. The upper rows of spheres 10 of the first matrix seat on the lower spheres of the second matrix in such a way that most of the upper spheres each are supported on four lower spheres.

25

The upper spheres 10 located in perforations 18 of sheet 6 are such as to allow free rotation of spheres 10. Similarly, perforations 20 in lower sheet 8 allow free rotation of spheres 14. Since the upper spheres are seated on the lower spheres, any rotation of the lower spheres will cause counter rotation of the upper spheres. In this way, any movement of bearing 1 when placed on the ground will cause the upper spheres to move in the opposite direction to the bearing.

35

The spheres 10 and 14 are preferably made of hard plastics

material about 20 mm in diameter and should be substantially inflexible whilst the sheets 6 and 8 require to be sufficiently rigid to maintain the spheres in their correct location but at the same time to have a certain degree of flexibility to allow for the bearing to move over an uneven surface.

In Figure 4, the bearing 1 is attached detachably to an inflatable platform 22 which is kept rigid only by inflation through nozzle 24 and by carrying handles 26 inserted in sleeves 28 on either side of the platform. The attachment of bearing 1 to platform 22 may be by any suitable means such as buttons or by hook and loop material like Velcro (Registered Trademark).

In order to move a patient from an accident site, the bearing 1 is placed at the foot end of the patient with the chamfered slope 4 towards the patient. The rods 26 with hooks 30 at their ends are then hooked on to loops 32. The platform 22 is attached to the bearing at an attachment 34 and the bearing is then pulled by the rescuers under the patient in direction Z. Because the upper spheres 10 on the bearing rotate with ground movement in direction X, which is contrary to movement of bearing Z, the patient is not moved relative to the ground in the horizontal direction although of course there will be slight lifting of the patient in the vertical direction. The platform 22 is made of a suitably smooth material so that as the patient moves over the bearing and beyond the bearing, the patient will be gradually moved on to platform 22. Poles 26 are then inserted in sleeves 28; the bearing is detached from the platform and the patient is then stretched away. The spheres when laid under the patient act to massage the patient who if able to move can be assisted in this movement by the bearing. In an alternative use, the bearing without platform 22 can be laid on to a bed, the bearing being of such a size as to cover perhaps half or quarter of a bed and

either used to transfer a patient from a stretcher on to the bed or else pulled under the patient so that the patient can be lifted off the bed for changing sheets. For this purpose the spheres 50 (see Figures 5 and 6) are about 5 mm in diameter or less. The bearing for this embodiment is formed by threading the spheres on sacrificial thread 52 and weaving the threaded spheres into a matrix, then dissolving the sacrificial thread to leave the spheres rotatably supported by the weave 54 of the woven matrix.

Figure 7, 8 and 9 show a substantially rigid composite plate 60 incorporating the bearing of the invention in which a first matrix 62 of spheres 61 is located above a second matrix 64. Each matrix is carried in a perforated sub plate 65, 65' which are secured together as shown in Figure 7.

In Figure 9 there can be seen telescopic arms 70 which attach by means of ball joints 72 and brackets 74 to the top sub plate 65'. These arms are designed to push the plate 60 under an article, in particular an injured person, so that the person is not subject to injurious movement whilst being transferred from one location (e.g. an accident site) to another (e.g. an ambulance). Carrying handles (not shown) can be provided on the plate.

Figure 10 is a diagrammatic view of, for instance, a ship to shore gangway or vehicular connection between shore and pontoon - the relative movement between ship and shore is similar to that between pontoon and shore. In this case, the shore is shown at 80 and pontoon at 82. Between shore and pontoon is a "bridge" 84 which has a semi spherical bearing surface 85 at one end and a bearing plate 86 mounted at 87 to the bridge.

The bearing surface 85 fits over a spherical plate 88 of spheres 89 of, say, between 2.5 and 7.5 mm held in two matrices 90 and 92. Matrices 90 and 92 are fixed to semi

spherical post head 94, fixed to shore 80. This arrangement allows the bridge to incline or to move in azimuth relative to the shore. At the pontoon end of the bridge, the bearing plate 86 also includes a pair of matrices 96 and 98 of spheres 100 of, say, 15 to 25 mm. Because of the interconnection between the matrices 96 and 98, the pontoon end of the bridge is able to move relative to the pontoon 82, transversely with respect to the pontoon or towards or away from the pontoon. The spheres 100 are larger than the spheres 89 to allow for the rougher upper surface 101 of pontoon 82, compared to the semi spherical post head 94.

Figure 11 shows a different application for the invention for supporting a bridge deck 110 on a vertical structure 112 where a small amount of lateral and longitudinal movement is required. The bearing shown has an upper member 114, seating via an elastomeric junction portion 116 of a lower member 118. The lower member has a first matrix 120 of spheres 121 which seat on a separate matrix 122 of spheres 121, both the matrices 120 and 122 being limited for movement by surround 124. The upper member 114 is also located relative decking 110 by surround 126. The design of the lower surround 124 and the height of the surround depend on the relative movement between structures 110 and 112 which are anticipated. The arrangement is designed to reduce the stress in the elastomeric joint 116 which only needs to account for vertical movement.

Figure 12 shows an arrangement which, depending upon the interpretation of the cross section, can either provide for circular or rectilinear movement. The arrangement can also provide for both rectilinear and circular movement in the same embodiment. The application is intended for a heavy civil engineering solution where the track formation shown at 130, having track 132, is formed where necessary with a lower track bedding plate 134. A leg 136 has a footplate 138 which can be square or circular and which sits on a twin matrix frame 140, each matrix having spheres 142.

CLAIMS

1. A bearing comprising a frame at least partly
5 surrounding two matrices each of a plurality of spheres,
each matrix when flat having its spheres mounted for
rotation in substantially a single planar or at least part
spherical plane, the plane of one matrix being parallel to
10 that of the other matrix, the spheres of one matrix located
so as to lie at least mostly against the spheres of the
other matrix so that rotation of spheres of one matrix
results in counter rotation of spheres of the other matrix.
2. A bearing according to claim 1 wherein the spheres are
15 between 25 mm and 15 mm in diameter.
3. A bearing according to claim 1 or 2 further comprising
an inflatable platform arranged to be detachably joined to
the bearing.
- 20 4. A bearing according to claim 3 wherein the inflatable
platform is provided with detachable poles disposable on
either side of the platform and so arranged for carrying the
platform.
- 25 5. A bearing according to claim 1 wherein the spheres are
between 2.5 and 7.5 mm in diameter.
6. A bearing according to claim 1 or 5 wherein the spheres
30 are woven into each matrix.
7. A bearing as claimed in claim 1 wherein the matrices
are curved in one or more planes.
- 35 8. A bearing as claimed in claim 1 wherein the frame is
attached to an upper or lower member via an elastomeric
layer.

9. A bearing as claimed in claim 1 as fitted into a rectilinear or circular track.

5 10. A bearing substantially as described with reference to any one or more of the accompanying drawings.

-1/8-

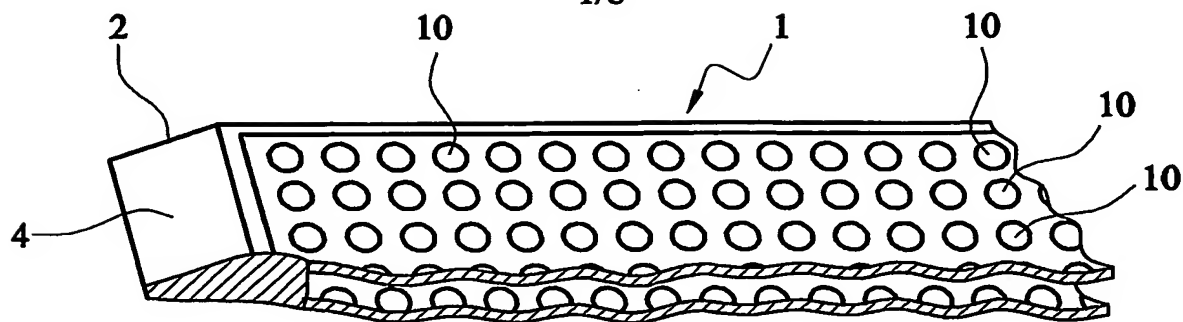


FIG. 1

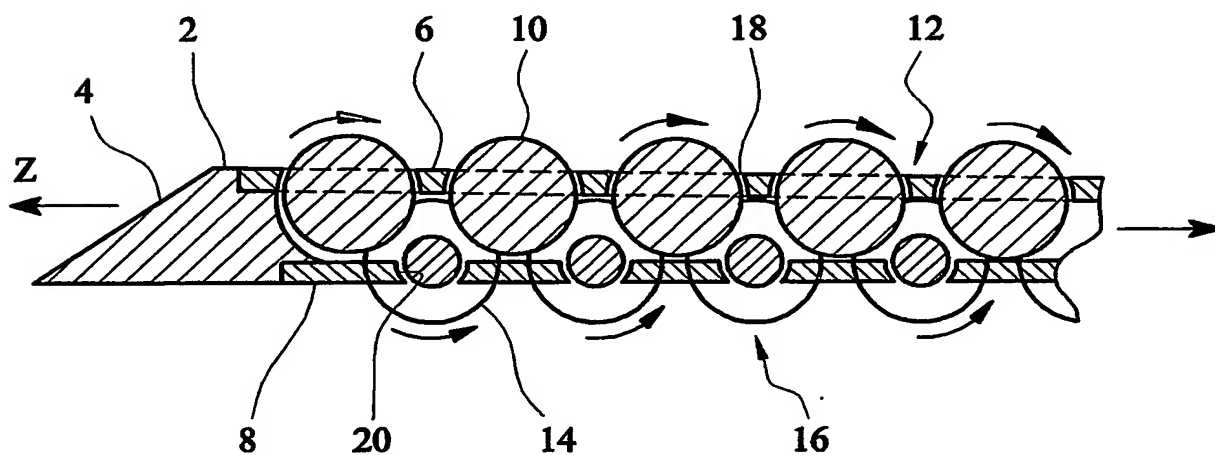


FIG. 2

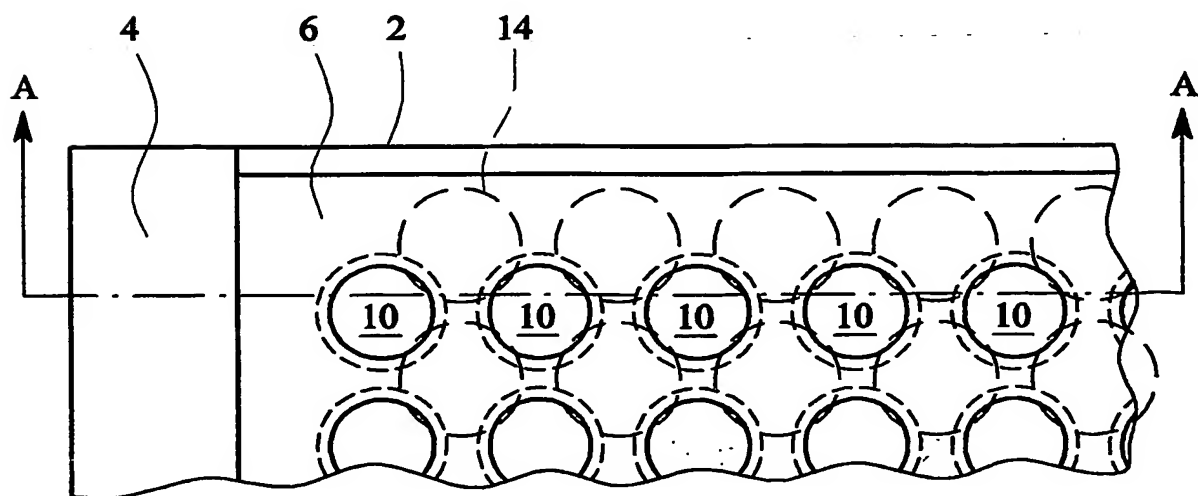


FIG. 3

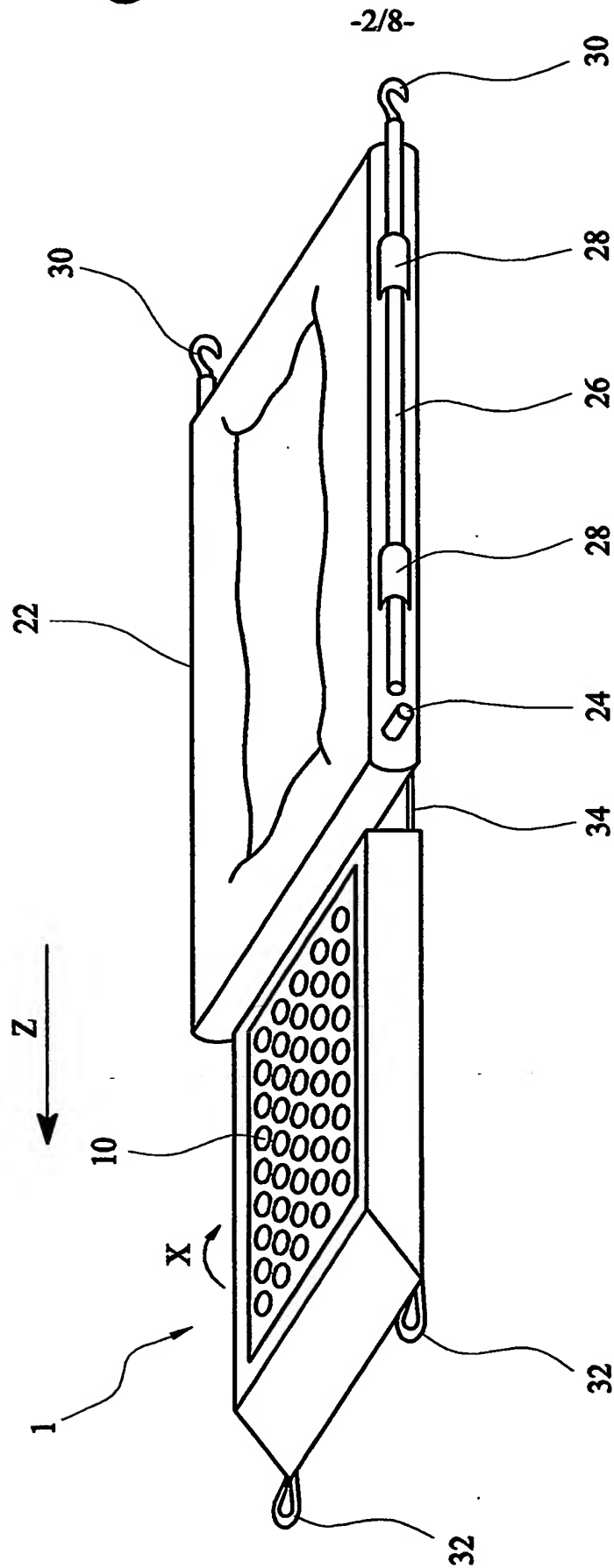


FIG. 4

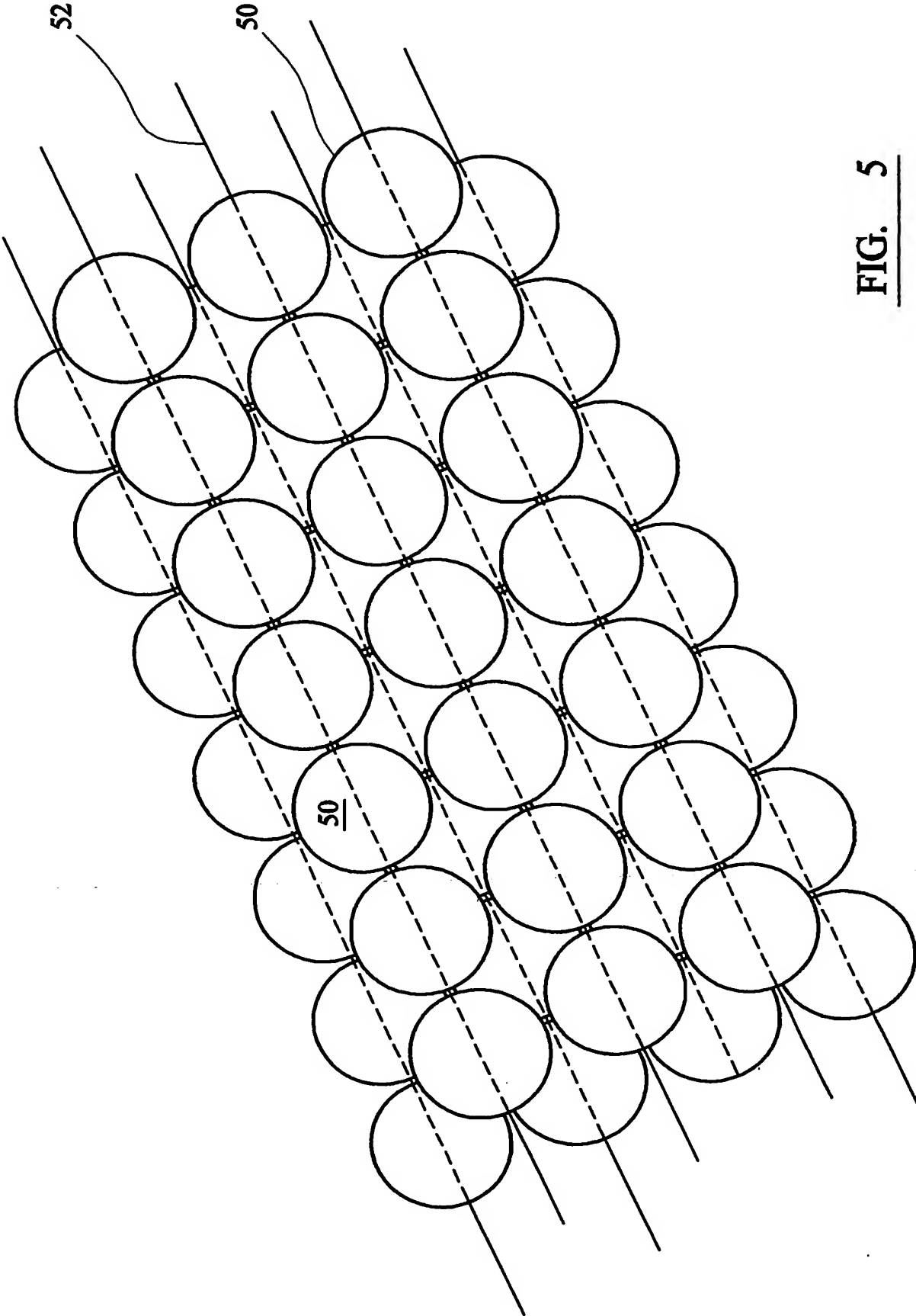


FIG. 5

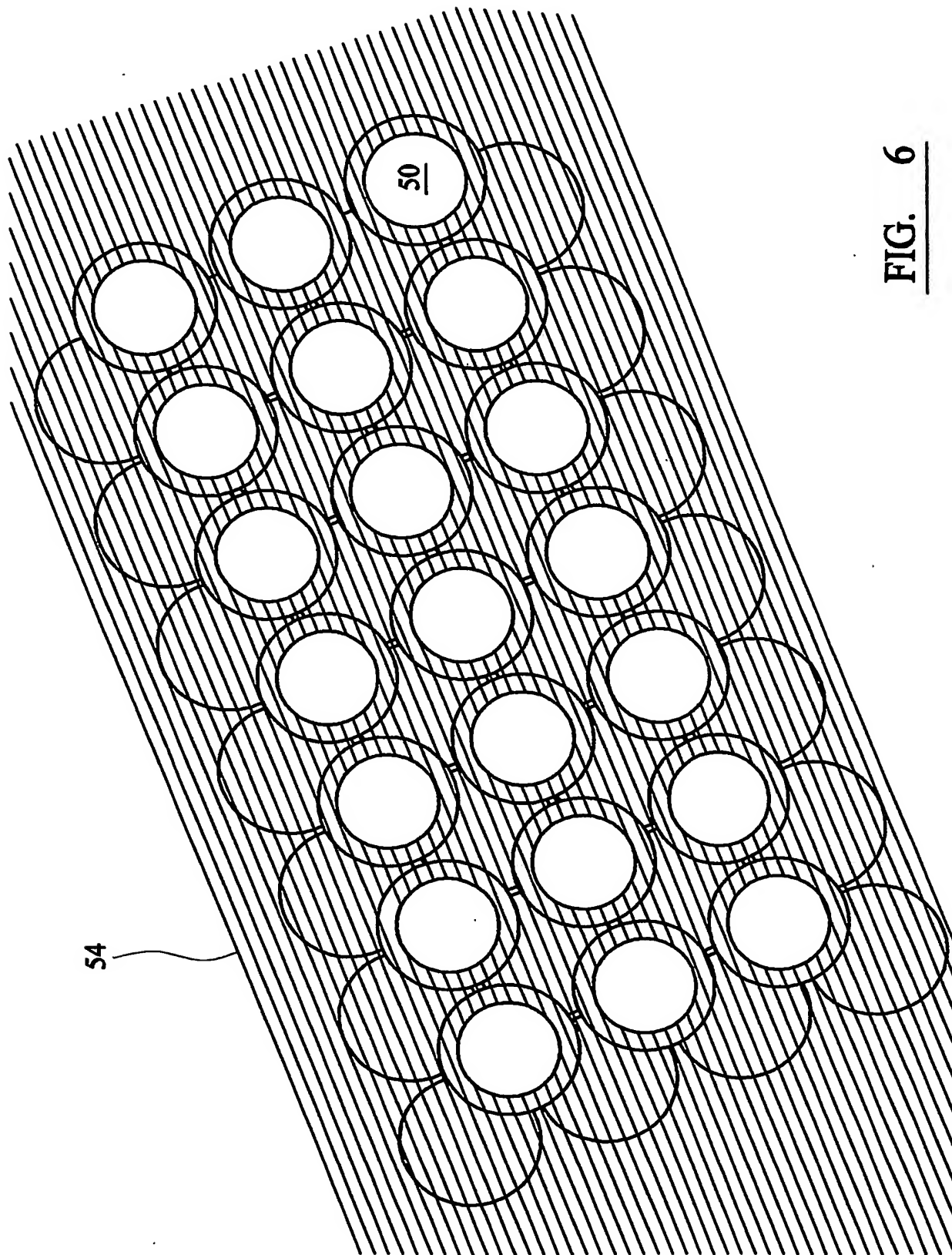


FIG. 6

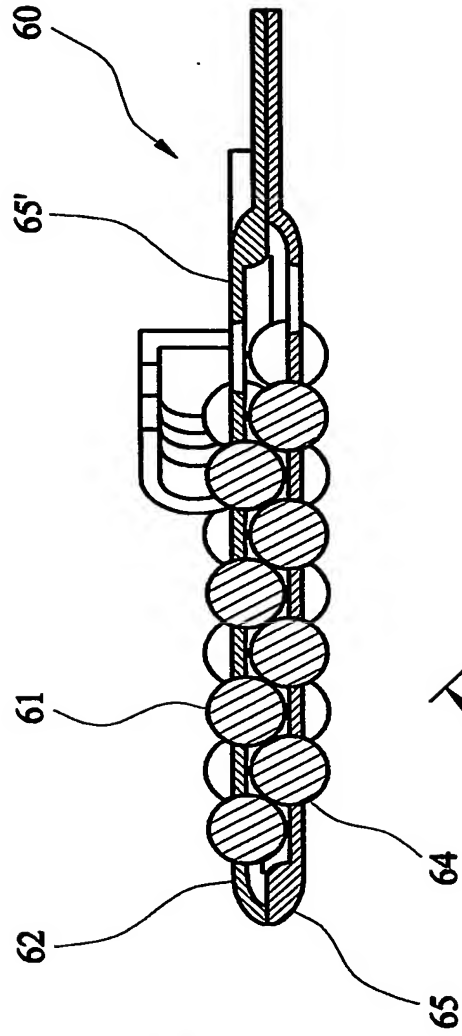


FIG. 7

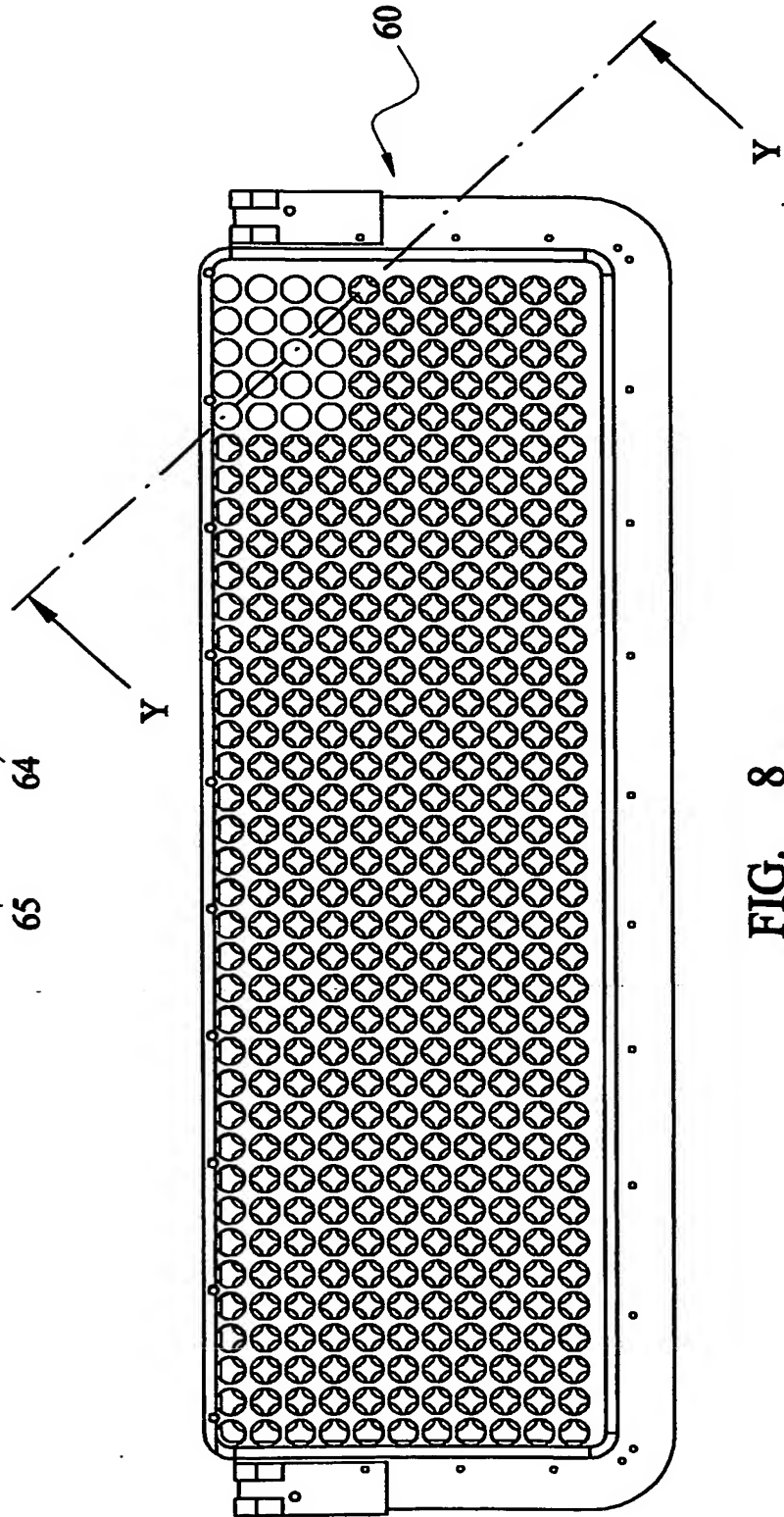


FIG. 8

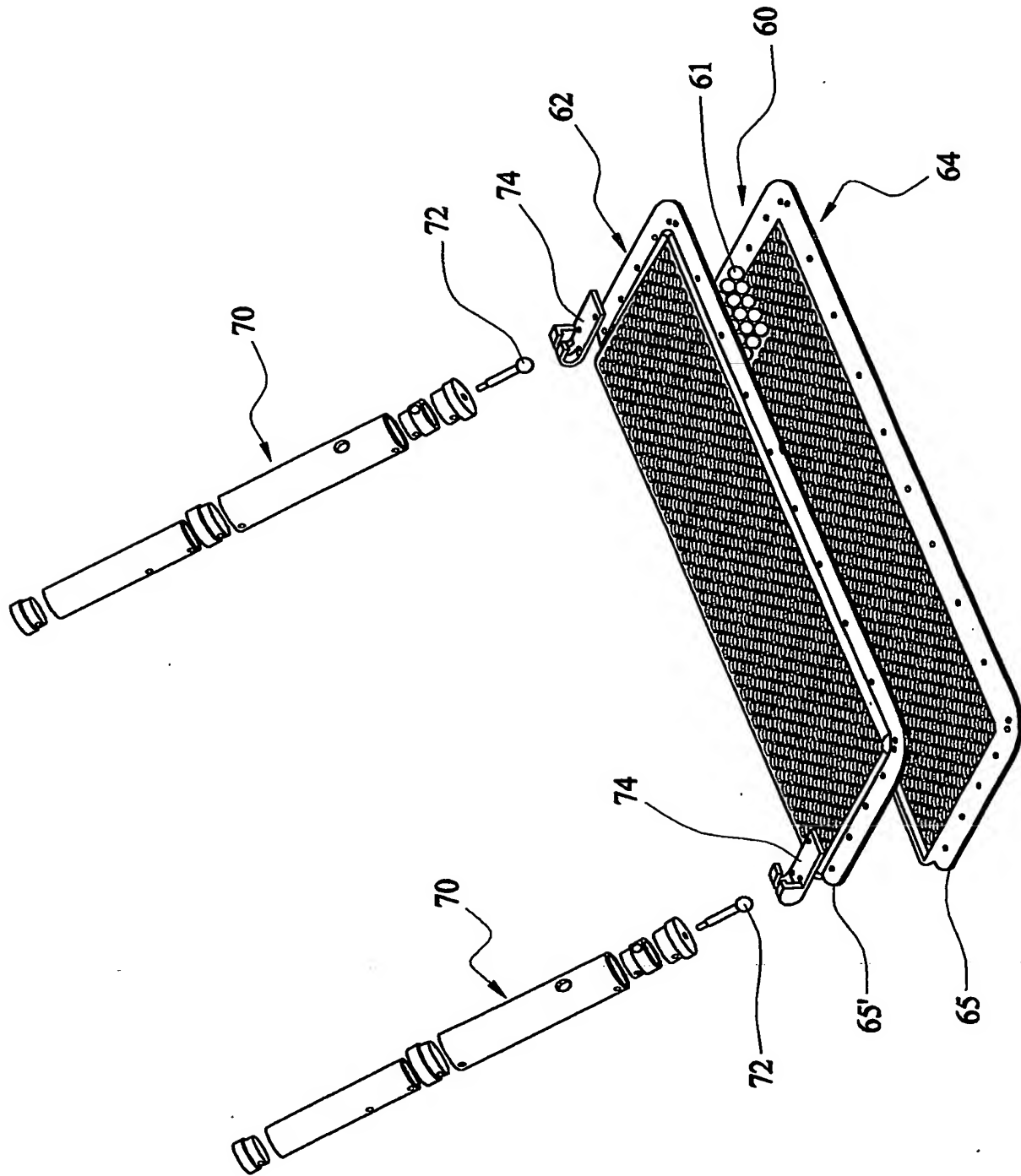


FIG. 9

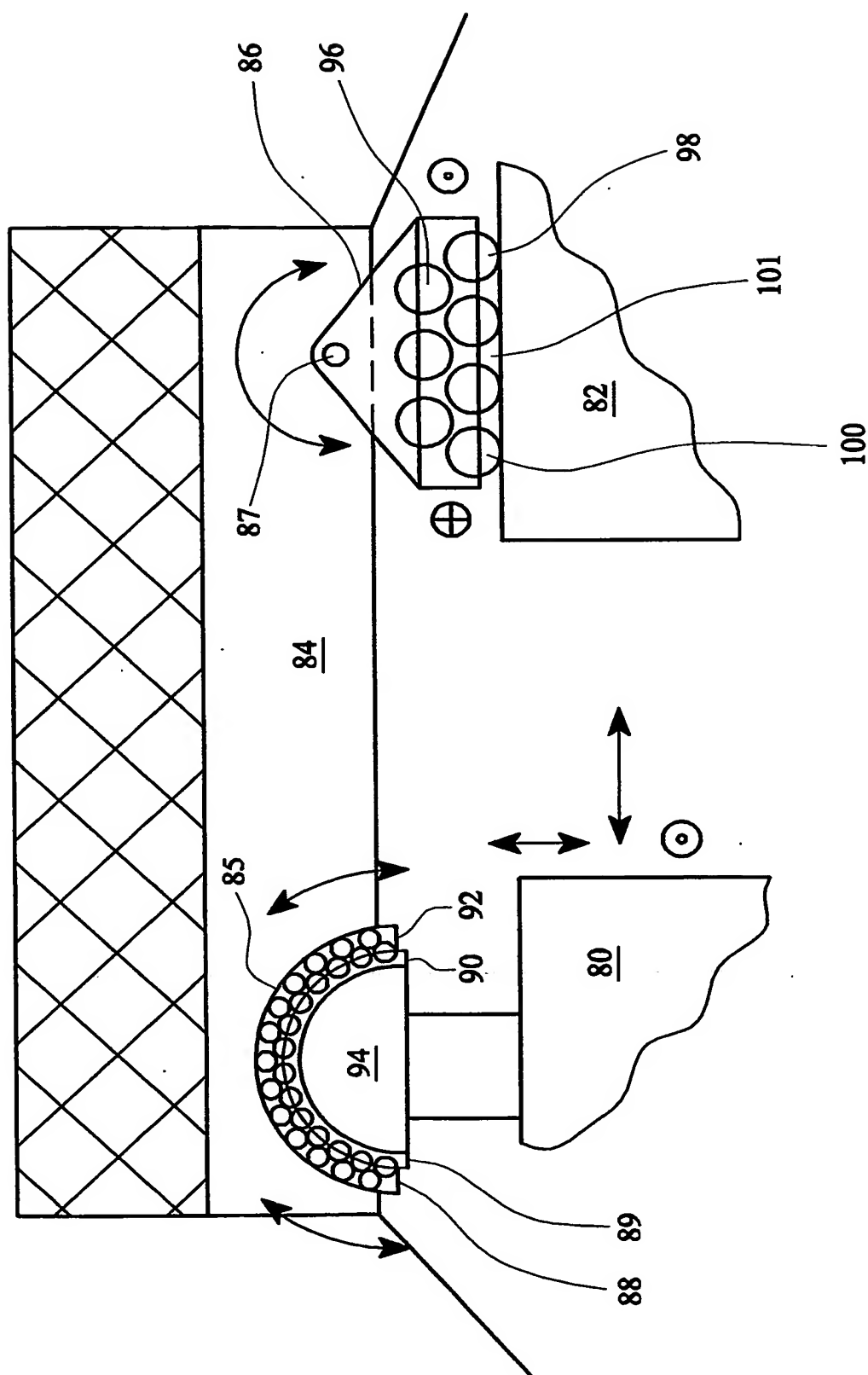


FIG. 10

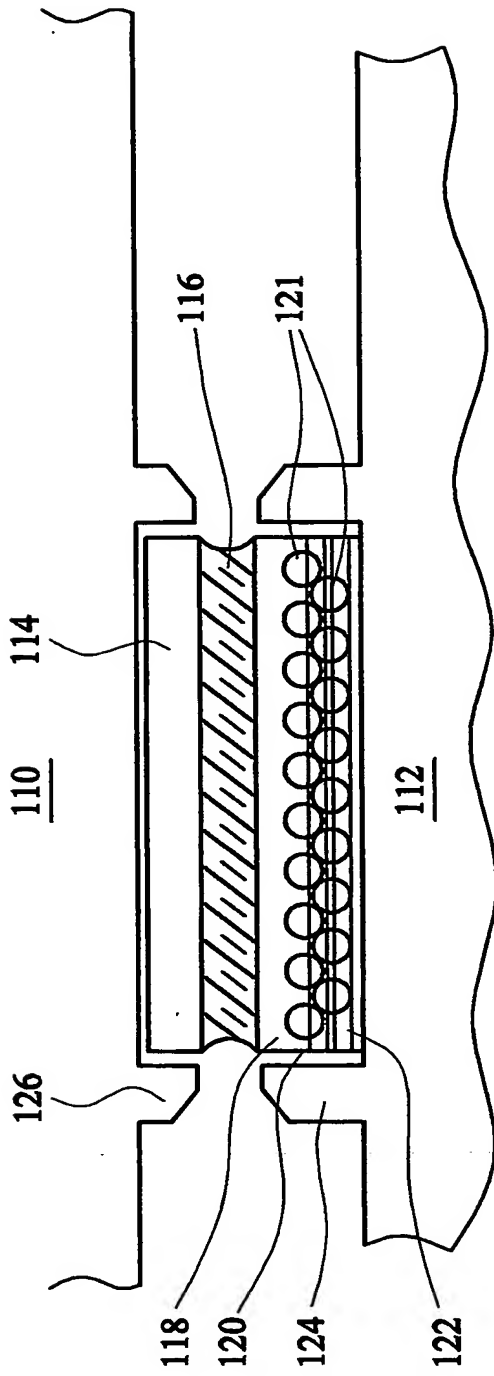


FIG. 11

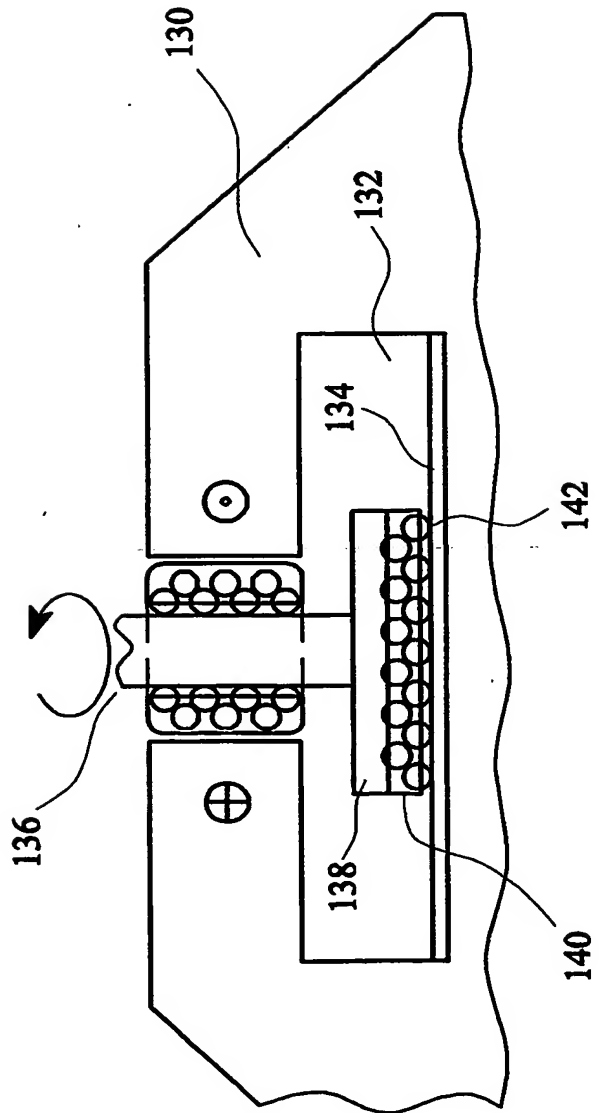


FIG. 12

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☒ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.